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Effect of Hormonal Treatment on Propagation of *Jatropha curcus*

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A B S T R A C T

Study on vegetative propagation in *Jatropha curcas* clearly indicates the response of different treatments in relation to different characters under observation. IBA treatments of concentration 50 and 75 ppm (24 hour dip) was found reasonably good for getting higher rooting percent, good survival of rooted plants and more vigour than other treatments. In terms of rooting response and survival of rooted plants, IBA treatment with 1000ppm and 1500 ppm concentration (5 minutes dip) performed better over other treatments. Lack of well developed rotting system in higher concentration of IBA through exogenous application seems that it has raised the IBA content to supra optimal level causing considerable reduction in rooting. In the absence of growth regulators, distilled water treatment can serve the purpose of cloning to some extent in this species.

Introduction

Jatropha is a genus from the family Euphorbiaceae closely related to other important cultivated plants like rubber tree & castor etc. The name is derived from the Greek words ἰατρός (*iatros*), meaning "physician," and τροφή (*trophe*), meaning "nutrition," hence the common name physic nut. Jatropha is distributed throughout the world mainly in tropical region (Chopra *et al.*, 1958) while it is native to Mexico and Central America and now being naturalized in most of the parts of India. *Jatropha curcas* L. is a deciduous shrub or small tree that grows to a height of about 5 m. It has smooth bark, sturdy branches, and thick papery leaves. Branches contain latex. Plant is monoceious and flowers are unisexual, occasionally hermaphrodite flowers occur (Gargi Joshi *et al.*, 2011). According to Heller (1996), inflorescence is cyme type; formed terminally on branches, possessing main and co-florescences with paracladia. The terminal inflorescences of the Jatropha plant have greenish yellow unisexual flowers that are dominantly male (2-19 female, 17-105 male). The female-to-male flowers ratio varies from 13:1 to 29:1 (Kumar and Tewari, 2015). Flowering in Jatropha occurs during wet season and two flowering peaks are obtained; one during summer and the other during

autumn. This species bear fruits 3 to 4 years after being planted in the dry regions and reaches the full fruit period in the fifth year.

The maximum and minimum average temperature in the natural zone of *J. curcas* is 46°C and 12°C. The annual rainfall ranges between 900 to 1200 mm which is mostly reached during monsoon whereas summer months are generally dry. The tree can grow in barren, gravelly, poor, sandy, loam and shallow soil whereas it cannot grow properly in the water stagnant area because it is sensitive to water logged condition (Arvind Bijalwan and Tarun Thakur, 2010**).** It is resistant to drought and pests as well.

There are more than 200 different names for its great significance to man and the various possibilities of its uses. In village it is used as an illuminant as it burns bricants and candles as in case of castor oil. The protein content of Jatropha oil cake may be used as raw material for plastics and synthetic fibers. It would also be advantageous to make use of Jatropha oil as hydraulic oil. Its latex contains an alkaloid known as "Jatrophine" which is believed to be having anti-cancerous properties, apart from many other medicinal uses. Jatropha curcas seed have about 32-40% valuable oil used to produce biofuel, therefore, it could be the source for biodiesel production particularly in arid and semiarid regions (Abobatta Waleed, 2019). The remaining press cake of jatropha seeds after oil extraction could also be considered for energy production, by processing and using as biomass feedstock to power electricity plants or as fertilizer (it contains nitrogen, phosphorus and potassium) (Achten WMJ *et al.,* 2008). The depletion of crude oil reserves coupled with the awareness of environmental issues and escalating petroleum prices have stimulated the search for alternatives to reduce overdependence on conventional fossil fuels (Tobib, H.M. *et al.,*2019). Recently, it has been found that in a country like India, where there is paucity of indigenous fossil fuel with limited resources, the *J. curcas* seems to be an economical and environmental friendly approach (Euler and Gorriz, 2004). It is a non–conventional energy crop and its oil is environmentally safe as well as cost effective. It is a promising substitute to kerosene and oil can be used in blended form with diesel. This non-conventional source of energy will save considerable foreign exchange and help in removing regional imbalance in energy use by making energy available all over India in a decentralized manner. For this kind of use there will be unlimited potential to take care of its production on a massive scale. *Jatropha curcus* is found in India in semi-wild condition in the vicinity of villages.. It grows rapidly, in hardy to dry weather conditions and is not browsed by goat or cattle. It can be cut or lopped at any desired height and is well adapted for hedges. However, despite their abundance and use as oil and reclamation plants, none of the *Jatropha* species have been properly domesticated and, as a result, their productivity is variable.

Jatropha curcas is usually propagated by seed but the number of seeds produced per plant is very low and the seeds have a limited viability. While propagation with seeds not only results in cross pollination but also creates abundant variability at genetic level in growth parameters as well as yield of seed and content of oil etc (Maya Kumari,*et al.*,2010). However multiplying clonally serves a benefit of producing clones which are true-to-type to valuable elite germplasm (Kochhar, *et al.,* 2008). In spite of all these supreme characteristics research on cultivation and propagation of Jatropha has been limited. As rooting is a crucial step in the propagation of woody plants and there is a great variability in the rooting ability of different species. Most of the species propagating naturally through vegetatives

means, forms adventitious roots without the requirement for application of hormones but a few others need growth hormones generally auxins (Syros, T. *et al.*, 2004). IAA as well as IBA have a great usage as it plays a significant role by breakage of root apical dominance thus inducing formation of root (Cline, 2000). Effect of hormonal treatment on germination of seed and its dormancy have also been described which takes place due to their effect on various seed parts (Idu, *et al.*,) (Koornneef *et al.*, 2007) (Kucera, *et al.*, 2005). Thus a systematic study was taken up to assess the effect of IBA treatment on propagation of *Jatropha* through stem cuttings.

Materials and Methods

The present study at Institute of Agricultural Sciences, Bundelkhand University, Jhansi (U.P.) For conducting the experiment on vegetative propagation techniques in *Jatropha curcus*, plants from about 4-5 years old plantations were selected. From these plantations stem cuttings of uniform size of about 15 c.m. long & 1.5-2.0 c.m. in diameter were taken from selected plants and cuttings were used for each treatment. From each branch cuttings leaves were removed and top cut end of cuttings were sealed with molten wax to reduce water loss. In this experiment two sets of treatments were used. One set comprised treatment of 24 hours dip in IBA or distilled water where as second set of experiment comprised of quick dip (5 minutes) in IBA or distilled water. For first set of experiment the cuttings were divided in 7 groups, each group consisting of 60 cuttings these were replicated thrice. Group 1 to 6 was treated with IBA solutions of different concentrations viz 25, 50, 75, 100, 125 and 150 ppm and group 7 served as control (distilled water treatment). All these cuttings were given treatment by the above mentioned concentration of IBA solution for twenty four hours by dipping 5 c.m. basal portion in the test solution. Same procedure was applied for distilled water treatment. After 24 hours treatment, the treatment cuttings were then planted in the ordinary nursery bed having sand and FYM mixture (1:1). Similarly for second set of experiments the cuttings were divided in six groups. Group 1 to 5 was treated with IBA solutions of different concentrations viz 500, 1000, 1500, 2000 and 2500 ppm and group 6 served as control (distilled water treatment). Here also in each group 60 cuttings were used for observation & all these cuttings were replicated thrice. The branch cuttings were treated with known concentration of IBA solution for 5 minute by dipping 5 cm basal portion in the test solution. After the treatment, the treated cuttings were planted in the ordinary nursery bed having sand and FYM mixture (1:1). The observations were recorded through out the period of experiment.

Results and Discussion

The responses of IBA treatment (24 hours treatment) for different treatments were observed on the days of sprouting, root initiation and rooting percent. For treatments IBA 25, 75, 125 and 150 ppm it was completed on 19th day whereas in IBA 50 ppm, sprouting was completed on 15^{th} day and in IBA 100 ppm sprouting was over on 17^{th} day after plantation. In the control treatment, it took maximum time to start for sprouting that is 5^{th} day and it was completed on 13^{th} day after plantation. Thus in case of control the sprouting was completed in 8 days only which is the lowest period as compared to all concentrations of IBA. For root initiation, it started from 19^{th} day at IBA 25 ppm. Whereas in IBA 50, 75 and 100 ppm, root initiation started from 20^{th} day after plantation. Similarly for IBA 125 and 150 ppm, root initiation started from 21^{st} day. The completion of root initiation took place on

32nd day for IBA 25ppm and for IBA 50 and 100 ppm initiation of rooting was completed on 28th day after plantation. For the treatment IBA 125 and 150 ppm completion of days for root initiation was 30. For the treatment 125 and 150ppm completion of days for root initiation took more time and it was 31 and 41 days respectively. In case of the treatment of the distilled water, root initiation was completed on 41st day. For rooting percent, 25 ppm IBA gave minimum 66.86% rooting IBA 75ppm resulted in 73.34 % were recorded maximum rooting. Under the treatment of distilled water, the rooting percent was 60.00. The experimental findings clearly indicate that there was decrease in rooting percent when the concentration of IBA was increased beyond 75ppm. The reason behind lack of well developed rooting system in higher concentrations of IBA through exogenous application seems that it has raised the IBA content to supra optimal level causing considerable reduction in rooting (Nanda *et al.*, 1968). The percent survivability of rooted plants in each treatment was critically put under observation and their performances were recorded. In general, it was clearly revealed that for all the treatments survivability of rooted plants was not less than 80 percent. For IBA 25ppm, the survivability of rooted plants was 80 percent. For IBA 50,100,125 and 150 ppm the survivability was 82.85, 84.50, 83.32 and 83.33% respectively. Thus we can say that survivability of rooted plants was more or less same (table-1). IBA 75 ppm treatment gave 88.81 percent survivability which was highest amongst all the treatments. In case of distilled water, the percent survivability was 85.86 which was quite good. Days for emergence of primary leaves gives a preliminary idea that after how many days of treatment, emergence of primary leaves started. For IBA 25 ppm, day's f or emergence of primary leaves was 17. On the other hand, for IBA 50 and 75 ppm, days taken for emergence of primary leaves were 18 (Table-1). Days for emergence of primary leaves for IBA 100ppm was 19 and for other treatments that is IBA 125 and 150 ppm, it was 21 days. For distilled water, it took 17 days for emergence of primary leaves. Thus we see that in the treatment of higher concentration, days for emergence of primary leaves were more as compared to treatments of less concentration. Number of primary leaves indicate the response of treatments on overall performance of rooting.

Average no. of primary leaves was 11.83 for the IBA 25 ppm. As the concentration of IBA was increased up to a certain level, the number of primary leaves per rooted plant also increased. The experimental findings revealed that for IBA50, 75, and 100 ppm, average no. of primary leaves was 14.00, 14.57, and 13.62 respectively (Table-1). After moving to higher concentration, the response came to lower side as it was observed in case of other characters under observation. For IBA 125 and 150 ppm, the average number of primary leaves was 11.42 and 11.00 respectively. For distilled water (control), the average number of primary leaves was 13.50. In this experiment the data was also recorded that flowering started after how many days of treatment and in different treatments it took how many days for completion of flowering. In IBA 25ppm flowering started from 26th day and was completed on 31st day. In case of IBA 50 and 75 ppm, days for flowering were 26-28 and 26-29 respectively (Table-1). This clearly indicates that for these two treatments time interval was less and flowering was completed within 3-4 days. Similarly for IBA 100 and 125 ppm, days taken for flowering were 26-31. Interestingly for all the treatments initiation of flowering started on 26th day but completion of flowering varied. For IBA 150 ppm, completion of flowering took more days i.e. 26-39 days and for the distilled water treatment it was 26-41 days.

Table.1 Rooting in stem cutting of *Jatropha curcas* through IBA treatments (24 hours dip)

Treatment (ppm)	No. of cutting	Days for sprouting	Days of root initiation	% Rooting	Survival % of rooted plants	Days for emergence of primary leaves	Average number of primary leaves	Days of flowering	% of flowering plants
25	45	4- 19	19 - 32	66.86	80.00	17	11.83	26 -31	**37**
50	45	4 - 15	20 - 28	68.60	82.85	18	14.00	26 -28	**43**
75	45	4 - 19	20 - 30	73.34	88.81	18	14.57	26 -29	**55**
100	45	4 - 17	20 - 28	53.35	84.50	19	13.62	26 -31	**33**
125	45	4 - 19	21- 31	53.30	83.32	21	11.42	26 -31	**28**
150	45	4 - 19	21- 41	40.00	83.33	21	11.00	26 -39	**20**
Control	**45**	**5 - 13**	**20 -41**	**60.00**	**85.88**	**17**	**13.50**	**26- 41**	**25**

Table.2 Rooting in stem cutting of *Jatropha curcas* through IBA treatments (5 minutes dip)

Treatment (ppm)	No. of cutting	Days for sprouting	Days of root initiation	% Rooting	Survival % of rooted plants	Days for emergence of primary leaves	Average number of primary leaves	Days of flowering	% of flowering plants
500	45	5- 17	20 - 40	50	80.00	18	9.28	24 -37	**22**
1000	45	5 -13	20 - 37	60	85.00	18	12.66	24 -29	**38**
1500	45	5 -18	23 - 40	60	88.33	19	13.20	24 -27	**47**
2000	45	5 - 19	24 - 43	45	83.88	19	11.21	24 -37	**30**
2500	45	5 - 17	20 - 40	35	85.71	18	10.00	24 -37	**18**
Control	**45**	**5 -12**	**19 - 38**	**45**	**75.52**	**16**	**10.10**	**25 -39**	**23**

This result clearly indicates that growth hormones play an important role in hastening the reproductive phase. Percent of flowering was observed 37% at 25ppm IBA concentration and the percentage of flowering plants increased in subsequent treatments. In IBA 50 and 75 ppm, the percent of flowering plants was 43 and 55 respectively. Again by going for higher concentration, the percent of flowering plants decreased. At IBA 125 and 150 ppm, the percent of flowering recorded was 28 and 20 respectively. Distilled water gave lowest percentage amongst all the treatments and it was only 25%.

In this set of experiment IBA treatment for 5 minute with higher concentrations of IBA were applied for very short period i.e. 3-4 minutes. In all the IBA treatments i.e. 500, 1000, 1500, 2000 and 2500 ppm, sprouting started from 5th day after plantation. For the treatment 500 and 2500 ppm i.e. lowest as well as highest concentration, process of sprouting completed on 17th day. For the treatment IBA 1000ppm, the completion of sprouting took place on 13th day whereas, for the IBA treatments 1500 and 2000 ppm, the completion for days of sprouting were 18 and 19 respectively. For the distilled water treatment i.e. control sprouting initiated on 5th day and process was completed on 12th day from the day of plantation. Initiation of rooting started from 20th day for the IBA treatments 500, 1000 and 2500 ppm whereas for the IBA treatment 1500 and 2000ppm, days for root initiation taken were 23 and 24 days respectively. For the completion of process of root initiation IBA 500, 1500 and 2500ppm took 40 days. For he treatment IBA 1000 ppm, the root initiation was completed on 37th day whereas for the treatment IBA 2000ppm process was completed on 43rd day. In case of distilled water treatment, the process of root initiation started from 19th day and the whole process of rot initiation was completed on 38th day after plantation. Success of vegetative propagation technique ultimately depends on the effect of growth regulator treatments on rooting response. For the treatment IBA 500 ppm, the rooting response was 50%. Experimental findings revealed that by going for higher concentration i.e. IBA 1000 and 1500 ppm the response of rooting percent obtained was 60 which was highest among all the treatments under study. Still moving to higher concentration from this level, retarding effect on root formation and rooting was observed. These results are in conformity with the experiment conducted by Narain and Watna (1983). Rooting for IBA concentration 2000 and 2500 ppm was 45 and 35 percent respectively. For the distilled water treatment the success of rooting was 55%. For IBA 500, 1000, 1500, 2000 and 2500ppm, the minimum survivability was 80% and it was upto 88.33% in certain set of treatments. For the treatments IBA 500 ppm, the survivability of rooted plants was 80%. The survivability of rooted plants was around 85% for the treatment IBA 1000 and 2500 ppm. For IBA 2000ppm, the survivability of rooted plants was 83.88%. In the whole set of experiment, the maximum survivability f rooted plants i.e. 88.33% was observed for IBA 1500 treatment. For distilled water treatment, the survivability of rooted plants was 78.52% which was little bit low in comparison to other set of treatments. The days for emergence of primary leaves were more or less same for all the treatments under study. For the treatments IBA 500, 1000 and 2500ppm emergence of primary leaves started from 18th day of the experiment. More or less same result was observed for the IBA treatments 1500 and 2000 ppm and it was 19 days from the day of start of experiment. In this set of experiment, days for emergence of primary leaves for distilled water treatment were 16th day from the day of plantation. It was observed that for the lowest as well as for the highest concentration of IBA, the numbers

of primary leaves were less in comparison to IBA concentrations of in between two extremes. For the treatment IBA 500 and 2500 ppm, the average number of primary leaves was 9.28 and 10.00, respectively. For the treatment IBA 1000ppm, the average number of leaves was 12.66 and it was maximum for the treatment IBA 1500 ppm i.e. 13.20. Further it was decreased by increasing the concentration of IBA solution. For the control i.e. distilled water treatment, the average numbers of primary leaves were 10.10. The days for flowering in different treatments of growth regulators were recorded. For the treatment IBA 500 ppm, days for flowering started from 24th day after treatment and flowering was completed on 37th day. On the other hand for the treatment IBA 1000 and 1500 ppm, days for flowering were 24 -29 and 24 -27 days respectively. In this set of experiment, initiation of flowering to completion of flowering was less in treatment IBA 1500 ppm as compare to other treatment including control. On the other hand, for the treatment IBA 2000 and 2500 ppm days taken for the flowering was 24 -37 days. For the treatment distilled water, the time taken for initiation to completion of flowering was 25-39 days which was longer in duration in comparison to the entire growth regulator.

The experimental result revealed that for the treatment IBA 500 ppm the minimum percent of flowering plant was recorded 22% whereas the treatment IBA 1500 ppm was maximum percent of flowering 47 were recorded. Again by going higher concentration IBA 2000 and 2500 ppm, the percent flowering were decreased as 30 and 18 respectively (Table-2). In case of distilled water treatment (control), the percent of flowering plants among rooted plants was 23 which were more or less same in comparison to previous set of experiment.

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